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NEXT APPARITION

OF

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Lovers of astronomical science who are still in middle life cannot fail to have noticed that, as regards the manifestation of those wonderful phenomena known as comets, they have been less favored than the generation immediately preceding our own. It is of course true that with the constant additions to the number of watchers of the sky, and with improved means of observation on every hand, the actual number of known comets has been largely augmented during the last half century and increases year by year.

I refer, however, to those splendid apparitions which, from the beginning of recorded history, have periodically excited the wonder and interest of mankind. It is now nearly twenty years

since a really great comet flamed in our skies. Our fathers, perhaps I should say our grandfathers, were more fortunate in their day. To them was given to behold the great comet of 1811, one of the most brilliant of modern times, which, contrary to the reputation of comets in general, was attended by bountiful harvests, abundant vintages, and a general plenty, including, it is said, an unusual number of twins born that year.

In 1835 astronomers were gladdened by the reappearance of the comet known as Halley's, of which more hereafter. Eight years later brought the great comet of 1843, perhaps the most splendid object of its class ever presented to the eye of man. Its tail extended over seventy degrees of heaven, and its brilliance was such as to render it distinctly visible to the naked eye at noon. Donati's comet in 1858 was the next imposing visitor, and the spectacle afforded by its transit over Arcturus formed a beautiful and impressive sight. Once more, in 1861, a large comet made its appearance, and thirteen years later another, known as Coggia's, traversed our skies. Then followed the comets of 1881 and 1882, since which latter date no comet of striking appearance has been seen. It is therefore not surprising that on the threshold of the twentieth century we should begin to realize the dearth of these phenomena in our own times, and to enquire how soon we may expect to be again favoured with the glorious spectacle of a great comet blazing in the heavens. To this question science can furnish no positive answer. The number of comets is legion. But an insignificant fraction of this number is known to us. The apparent size and brilliancy of these objects depend largely upon the nearness of their approach to our globe. It is quite possible that one of the myriad wanderers in the realms of space may dash into our system at any time, and in its headlong journey to the sun may cross our path at a point sufficiently near the earth to cause it to outvie in magnitude and splendour all previous apparitions. Apart from such a sudden and unlooked for contingency we shall have to possess our souls in patience for some years to come, for of nearly all the noted objects that have appeared in recent times, either their periods are infinite or are of such duration as to preclude the

possibility of our beholding them again, at any rate in this mortal life. The great comet of 1811 has a period of something like 3000 years. That of 1843 will not revisit our skies before the close of the 24th century, and a cycle four times as great must go round before Donati's comet comes again within hailing distance of the earth. Thus all we can ever hope to know of these bodies is already recorded in our libraries. Of them the future has naught in store for us. Fortunately the orbits of all the great comets are not traced on such ample lines. One—that associated with the illustrious name of Halley—is known to complete its elliptic course within the span allotted to human life. It last visited our system in the year 1835 and its reappearance in 1910 is confidently looked forward to.

As Halley's is the solitary known example of a conspicuous comet with a fixed period of less than a century, and as we all enjoy a reasonable expectation of beholding it with our own eyes, it may not be out of place to devote a few minutes to a consideration of its past history and approaching visit.

One sometimes meets with the reflection that the development of astronomical science has had the effect of dwarfing the human race—that in the light of the knowledge which a just conception of the universe reveals, man shrinks to absolute insignificance, and in his puny state is comparable only to a microscopic insect crawling on the rind of an orange. I confess that the impression which astronomy produces on my mind is rather the reverse of this. It is of course true that science acquaints us with the fact that our globe is but one of a host of worlds, and that *a fortiori* the dwellers thereon must, both in respect of their physical size and the shortness of their duration, occupy but an utterly insignificant relation to the sum of things. But humanity, I take it, is not to be gauged by pounds *avoirdupois*. 'The mind's the measure of the man,' and I submit that, judged by man's intellectual capacity, the disparity we are considering is by no means so overwhelming as some of our poets and philosophers are given to represent. The unaided intelligence that has reasoned out the plan of the universe—that has measured and weighed the earth we live on and the sun round which it moves

—that has determined the relative positions of the various planets and unlocked the mysteries of their complex motions—that, transcending the bounds of the solar system, has pierced the profoundest depths of space and proclaimed the nature and composition of those distant spheres which roll in the realms of the infinite—speaks to me rather of the godlike attributes of the great Creator than of the humblest works of His hand. And assuredly not the least wonderful of man's intellectual triumphs is afforded to us by him who has given his name to that most famous of all comets, to the reappearance of which we are already beginning to look forward.

At the time when Newton was engaged in developing his theory of gravitation a brilliant comet appeared, which, from its size and splendour, excited unusual interest. Suddenly flaming into view, it traversed the heavens with almost inconceivable rapidity, its speed exceeding at perihelion 350 miles a second. Approaching the sun within half the distance of the moon from the earth it swung round that luminary in two hours, and throwing off a train of light more than a hundred million miles in length, swept outwards into space and has never since been seen.

This mysterious stranger arrested the attention of the prince of philosophers himself, who sought to ascertain whether it too might not prove to be obedient to the controlling principle which (he had lately found) regulated the solar system. Its amazing velocity, however, rendered it an unsuitable object for his researches, and it was reserved to another illustrious Englishman —Edmund Halley—to complete the application of the law of universal gravitation to the cometary world which Newton had begun.

In 1682, the year following that which the comet observed by Newton disappeared, another came into view, affording Halley the opportunity for which he had been waiting. Having observed its position and compared its orbit with great care, he remarked that it showed a striking resemblance to the comets of 1531 and 1607, in fact their elements were nearly identical. Further investigation led him to extend his comparison to the comets which appeared in 1456 and 1380. All the information he could

gather of these earlier apparitions led him to suspect that they were but re-appearances of one and the same comet. His inference did not rest merely in the correspondence of the intervals. "Many things," he tells us, led him to believe that the comet of 1531, observed by Apian, was the same as that described by Kepler in 1697, and which he himself saw in 1682. The comet of 1456 was not observed astronomically, but the chronicles of the period record its motion being retrograde. Now, it is a peculiarity of Halley's Comet that with, I think, one exception, and that unknown to Halley, it is the only comet having an elliptical path and a period of less than a century, whose motion is from east to west. Struck by these coincidences he set about tracing the comet back to its first recorded appearance when it signalized the birth of Mithridates, 130 B.C., on which occasion it is said to have been visible twenty-four days and to have surpassed the sun in brightness; its tail extended forty-five degrees and it occupied four hours in rising and setting. Halley noted its successive visits in the years 323, 399, 550, 930, 1006, 1082, 1155, 1230, 1305, 1380, 1456, and so up to his own times which witnessed the twenty-fourth return from its first recorded appearance. He found it moving in a plane but little inclined to the ecliptic and in an ellipse of a very great eccentricity approaching the sun within about 55,000,000 miles and receding therefrom more than twice the distance of the planet Neptune. Becoming more and more convinced of the identity of the comet he was observing with those whose appearance I have mentioned, he set himself to work to compute its next return, and after long and laborious calculations announced that it would re-appear about the close of 1758 or the beginning of 1759. He was then a young man and outlived his prediction, made in 1705, nearly forty years. He could not, however, hope to see its realization and his words on this head are almost pathetic.

> "Wherefore if it should return according to our prediction about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman."

As a matter of fact he had been dead seventeen years when his prediction was fulfilled.

As the time for the verification of this announcement drew near, much interest prevailed in the astronomical world, and efforts were made to fix the date with greater precision than Halley had attempted. That eminent man realized that the imponderable, almost spiritual texture of a comet must be powerfully swayed by the attraction of the larger planets, but knowledge of the law of gravitation was in its infancy when Halley toiled over the problem as to the exact amount of perturbation his comet would be subjected to from this cause, and it was reserved for later investigators to solve it with that rigorous accuracy in which astronomers delight. The skilled French mathematicians, Clairaut and Lalande, undertook the task, which was one of enormous magnitude, involving the computation of all the perturbations the comet had undergone throughout a period of two revolutions, or 150 years. At length the laborious task was completed and the announcement made that the comet would be retarded 518 days by the influence of Jupiter, and 100 by Saturn—Clairaut fixing the date of its perihelion passage for the 13th April, 1759, with a margin of thirty days for possible error.

These results were communicated to the Academy of Sciences on the 14th November, 1758, and on the 25th ~~September~~ December following the comet was seen by one George Palitsh, a Saxon peasant in the environs of Dresden. It arrived at perihelion on the 13th March, 1759, just thirty days earlier than the date of Clairaut's prediction, but within the limits of error which he had assigned.

This certainly was a wonderful intellectual feat, and of a nature to make us proud of our race. The intervals between the comet's previous re-appearance had not been uniform. Considerable discrepancies existed. This visit was 586 days longer than the previous revolution, which makes the triumph of the astronomer all the greater. In a burst of enthusiasm Lalande exclaims:

"What are thirty-two days to an interval of more than 150 years, during only one two-hundredth part of which observations were made, the comet

being out of sight all the rest of the time? What are thirty-two days for all the other attractions of the solar system which have not been included; for all the comets, the situation and masses of which are unknown to us; for the resistance of the ethereal medium, which we are unable even to estimate, and for all these qualities which of necessity have been neglected in the approximations of the calculation? . . . A difference of 586 days between the revolutions of the same comet, a difference produced by the disturbing action of Jupiter and Saturn, affords a more striking demonstration of the great principle of attration than we could have dared to hope for, and places this law amongst the number of the fundamental truths of Physics, the reality of which it is no more possible to doubt than the existence of the bodies which produce it."

Lalande's gratification is all the more legitimate when it is considered that at the time when these predictions were made, the existence of neither Uranus nor Neptune was known. Yet the comet's path cuts the orbits of both these planets and consequently is more or less perturbed by them.

In the interval between 1759 and 1835, the date of the next appearance of Halley's comet, great strides had been made in the science of astronomy. The planet Uranus had been discovered, the masses of the larger planets were more accurately ascertained, and the methods for computing perturbations largely improved. Taking the perihelion passage of 1759 as the point of departure, and following in the steps of Clairault, two French savants, Messrs. Damoiseau and Pontecoulant, independently undertook the necessary calculations anew. Their results agreed within a few days, Mr. Damoiseau fixing the date of the comet's perihelion passage for the 4th November, 1835, and Mr. Pontecoulant ten days later. Two other astronomers, Messrs. Lehmann and Rosenberger, respectively, fixed the dates at November 11th and 26th. On this occasion not only was the perihelion passage computed, but the exact path of the comet among the stars mapped out, and the precise point indicated at which it would first be seen. The last of these predictions was published on the 25th July, 1835. On the evening of the 5th August Mr. Dumouchel, of the Observatory at Rome, directed his telescope to the prescribed spot, and there, within a degree of the place fixed by Rosenberger, was the comet, as yet but a faint stain of

light on the deep blue of the heavens. It arrived at perihelion on the 16th November, the difference between the observed and the mean of the computed dates being less than three days. On the 5th May, 1836, it finally ceased to be visible.

Once more, and with greatly improved facilities, astronomers addressed themselves to the task of tracing this wanderer in his mighty pilgrimage. The duration of the last period was found to be seventy-six years and 135 days. An equal period would bring the next perihelion passage to March 29th, 1912. It has been ascertained, however, that the next return will be somewhat accelerated by the attraction of Jupiter, and that the period of the revolution which the comet is now performing will be nearly two years less than on the previous occasion, and shorter than any hitherto predicted. According to the best authorities the next perihelion passage will take place on the 24th May, 1910.*

Accounts of past appearances of Halley's comet vary considerably in respect of its size and brilliancy. These discrepancies may no doubt be accounted for to a considerable extent by a comparison of its distances from our globe at successive visits. These necessarily ranged between wide limits. In 1835 the comet approached the earth within four and a half million miles. Doubtless there have been occasions when the earth was on the far side of its orbit at the time the comet crossed the ecliptic, in which event it would be separated by a much greater interval than in 1835, and consequently present a less conspicuous appearance.

Apart, however, from the apparent effect due to changes in relative positions, Halley's comet is remarkable for singular and sudden changes of aspect. During some time before and after its perihelion passage on November 16th, 1835, it appeared quite destitute of tail. Yet in the preceding October it had a tail extending twenty-four degrees, which Bessel describes as having been produced by emanations at first issuing from the comet in

* I have also seen the date given as the 16th May.

the direction of the sun, and being swept round as if by some repulsive force. Again, in the twenty-four hours from the 23rd to the 24th January, 1836, the brightness of its nucleus increased twenty fold.

These changes indicating as they do the operation on a vast scale of mighty forces unknown to man, add to the interest with which we look forward to the next return of Halley's Comet.